

Listing of Claims

The following is a complete listing of all the claims in the application, with an indication of the status of each:

- 1 1 (Currently amended). A protection switching method for a passive optical network (PON) system including
 - 3 an optical line terminal for switching between a first active-system transmission/reception section and a first standby-system transmission/reception section by using a switch,
 - 6 a plurality of network units for selectively connecting second active-system transmission/reception sections and second standby-system transmission/reception sections to subscriber terminals upon switching said sections through selectors in the event of a communication abnormality, and
 - 11 transmission paths for star-connecting said second active-system transmission/reception sections to said first active-system transmission/reception section, and also star-connecting said second standby-system transmission/reception sections to said first standby-system transmission/reception section, characterized by comprising the steps of:
 - 16 setting an active-system virtual path and a standby-system virtual path between said optical line terminal and said subscriber terminal in different time slot bands;
 - 19 outputting by said switch a data cell to one of a plurality of ports in the network units, to which said first active-system transmission/reception section and said first standby-system transmission/reception section are connected, in accordance with one of a header value added to the data cell or a time slot of a frame;
 - 24 detecting a communication abnormality in at least one active-system virtual path established between said optical line terminal and said subscriber terminal through said transmission path and said network unit; and

28 upon detection of a communication abnormality in the active-
29 system virtual path, switching by said switch to switch only the
30 transmission paths to establish a standby-system virtual path between said
31 optical line terminal and said subscriber terminal serving as a
32 communication partner, without affecting communication through ~~normal~~
33 other active virtual paths in the PON system.

1 2 (Previously Presented). A method according to claim 1, wherein the
2 method further comprises

3 the step of simultaneously transmitting warning signals indicating
4 communication abnormalities from said network units, and

5 the step of switching comprises the step of simultaneously
6 switching a plurality of active-system virtual paths between said optical
7 line terminal and said subscriber terminals to a plurality of standby-system
8 virtual paths by simultaneously switching/controlling all ports of said
9 switch in said optical line terminal upon reception of the warning signals.

1 3 (Previously Presented). A method according to claim 1, wherein the
2 method further comprises

3 the step of simultaneously transmitting warning signals indicating
4 communication abnormalities from said network units which have
5 accessed signals distributed from said optical line terminal, and

6 the step of switching comprises the step of simultaneously
7 switching a plurality of active-system virtual paths between said optical
8 line terminal and said subscriber terminals to a plurality of standby-system
9 virtual paths by simultaneously switching/controlling predetermined ports
10 of said switch in said optical line terminal upon reception of the warning
11 signals.

1 4 (Original). A method according to claim 1, further comprising the steps
2 of:

3 transmitting a selector switching signal from said optical line
4 terminal to said network unit when a communication abnormality in the
5 active-system virtual path is detected; and
6 selectively switching said active-system transmission/reception
7 section and said standby-system transmission/reception section in said
8 network unit when the selector switching signal is received.

5 (Canceled).

1 6 (Currently Amended). A method according to claim 1, wherein
2 the ~~the~~ step of setting, in different bands, a plurality of first active-
3 system virtual paths running through said first and second active-system
4 transmission/reception sections, establishes a plurality of second active-
5 system virtual paths running through said first and second standby-system
6 transmission/reception sections, first standby-system virtual paths running
7 through said first and second active-system transmission/reception
8 sections, and second standby-system virtual paths running through said
9 first and second standby-system transmission/reception sections, and
10 the step of switching comprises the step of switching the virtual
11 path to one of the first and second standby-system virtual paths through
12 said switch when a communication abnormality is detected in one of the
13 first and second active-system virtual paths.

1 7 (Original). A method according to claim 6, further comprising the step of
2 resetting the second active-system virtual path and the second standby-
3 system virtual path to share a band assigned to said first active-system
4 transmission/reception section when communication abnormalities are
5 detected in all said first active-system virtual paths.

1 8 (Original). A method according to claim 6, further comprising the step of

2 resetting the first active-system virtual path and the first standby-system
3 virtual path to share a band assigned to said first active-system
4 transmission/reception section when communication abnormalities are
5 detected in all said second active-system virtual paths.

1 9 (Previously Presented). A method according to claim 1, wherein the step
2 of switching comprises the step of, when a communication abnormality
3 occurs in one of the active-system virtual paths, limiting a band set for the
4 remaining normal active-system virtual paths and using a surplus band as a
5 standby-system virtual path.

1 10 (Previously Presented). A method according to claim 1, wherein the
2 method further comprises
3 the step of setting a plurality of active-system virtual paths and a
4 plurality of standby-system virtual paths, and
5 the step of switching further comprises the step of switching active-
6 system virtual paths, except for an active-system virtual path assigned to a
7 specific subscriber terminal for which no protection is required, to
8 standby-system virtual paths, except for a standby-system virtual path
9 assigned to said specific subscriber terminal, in the event of
10 communication abnormalities in the active-system virtual paths except for
11 the active-system virtual path assigned to said specific subscriber terminal.

1 11 (Previously Presented). A method according to claim 1, wherein the
2 method further comprises the steps of:
3 setting a plurality of active-system virtual paths between said
4 subscriber terminal and a plurality of first transmission/reception means
5 corresponding to said active-system transmission/reception section; and
6 setting a standby-system virtual path between said subscriber
7 terminal and second transmission/reception means corresponding to said
8 standby-system transmission/reception section, and

9 the step of switching comprises the step of, when an abnormality is
10 detected in an active-system virtual path, switching the active-system
11 virtual path in which the abnormality is detected to a standby-system
12 virtual path by using a band held by said second transmission/reception
13 means.

1 12 (Currently amended). A protection switching apparatus for a passive
2 optical network (PON) system characterized by comprising:

3 an optical line terminal having a first active-system
4 transmission/reception section and a first standby-system
5 transmission/reception section for transmitting/receiving signals and
6 detecting communication abnormalities in transmission paths;

7 a plurality of network units each having a second active-system
8 transmission/reception section and a second standby-system
9 transmission/reception section respectively connected to said first active-
10 system transmission/reception section and said standby-system
11 transmission/reception section through the transmission paths, said
12 network units being star-connected to said optical line terminal through the
13 transmission paths and active-system virtual paths and standby-system
14 virtual paths between said optical line terminal and said subscriber
15 terminal are set in different time slot bands;

16 selectors which are respectively arranged in said network units to
17 select said second active-system transmission/reception section and said
18 second standby-system transmission/reception section connected to normal
19 transmission paths, one of said selected second active-system
20 transmission/reception section and said selected second standby-system
21 transmission/reception section being connected to subscriber terminals;

22 a switch which is arranged in said optical line terminal to establish
23 a virtual path between said optical line terminal and said network unit by
24 switching and connecting the transmission path between said first active-
25 system transmission/reception section and said first standby-system

26 transmission/reception, said switch outputs a data cell to one of a plurality
27 of ports in the network units, to which said first active-system
28 transmission/reception section and said first standby-system
29 transmission/reception section are connected, in accordance with one of a
30 header value added to the data cell or a time slot of a frame; and

31 a first control section which is arranged in said optical line terminal
32 to control said switch, upon detection of a communication abnormality in
33 the transmission path, so as to switch only the abnormal transmission path
34 to a normal transmission path without affecting communication through
35 normal other active virtual paths in the PON system, thereby reestablishing
36 a virtual path to said subscriber terminal in which the communication
37 abnormality has occurred, the virtual path being constituted by an active-
38 system virtual path and a standby-system virtual path.

1 13 (Original). An apparatus according to claim 12, wherein the
2 transmission path is formed from a metal line.

1 14 (Original). An apparatus according to claim 12, wherein the
2 transmission path is formed from a coaxial cable.

1 15 (Original). An apparatus according to claim 12, wherein the
2 transmission path is an optical transmission path, and said network unit is
3 an optical network unit.

1 16 (Original). An apparatus according to claim 15, wherein the optical
2 transmission paths respectively star-connect said second active-system
3 transmission/reception section and said second standby-system
4 transmission/reception section to said first active-system
5 transmission/reception section and said first standby-system
6 transmission/reception section through photocouplers.

1 17 (Previously presented). An apparatus according to claim 12, wherein
2 said switch outputs an ATM (Asynchronous Transmission Mode) cell to
3 one of a plurality of ports, to which said first active-system
4 transmission/reception section and said first standby-system
5 transmission/reception section are connected, in accordance with a header
6 value added to the ATM cell.

1 18 (Original). An apparatus according to claim 12, wherein said switch
2 determines an output port for data in a synchronous transfer mode in
3 accordance with a time slot of a frame.

1 19 (Original). An apparatus according to claim 12, wherein said network
2 units transmit warning signals indicating communication abnormalities in
3 the transmission paths, and said first control section switches/controls all
4 ports of said switch to simultaneously switch virtual paths between said
5 optical line terminal and said subscriber terminals from active-system
6 virtual paths to standby-system virtual paths upon simultaneously
7 receiving the warning signals from said network units.

1 20 (Original). An apparatus according to claim 12, wherein said network
2 units which have accessed signals distributed from said optical line
3 terminal transmit warning signals indicating communication abnormalities
4 in the transmission paths, and said first control section switches/controls
5 predetermined ports of said switch to simultaneously switch virtual paths
6 between said optical line terminal and said subscriber terminals from
7 active-system virtual paths to standby-system virtual paths upon
8 simultaneously receiving the warning signals from said network units.

1 21 (Original). An apparatus according to claim 12, wherein said first
2 control section transmits a selector switching signal to said network unit
3 when a communication abnormality is detected in the transmission path,

4 and said network unit comprises a second control section for controlling
5 said selector to selectively switch said second active-system
6 transmission/reception section and said second standby-system
7 transmission/reception section upon reception of the selector switching
8 signal from said optical line terminal.

22 (Canceled).

1 23 (Original). An apparatus according to claim 12, wherein the virtual path
2 comprises a plurality of first active-system virtual paths running through
3 said first and second transmission/reception sections, a plurality of second
4 active-system virtual paths running through said first and second standby-
5 system transmission/reception sections, a first standby-system virtual path
6 running through said first and second active-system transmission/reception
7 sections, and a second standby-system virtual path running through said
8 first and second standby-system transmission/reception sections, the first
9 and second active-system virtual paths and the first and second standby-
10 system virtual paths being set in different bands, and said first control
11 section controls said switch to switch the virtual path to one of the first and
12 second standby-system virtual paths when a communication abnormality is
13 detected in one of the first and second active-system virtual paths.

1 24 (Original). An apparatus according to claim 23, wherein when
2 communication abnormalities are detected in all the first active-system
3 virtual paths, a second active-system virtual path and a second standby-
4 system virtual path are reset to share a band assigned to said first standby-
5 system transmission/reception section.

1 25 (Original). An apparatus according to claim 23, wherein when
2 communication abnormalities are detected in all the second active-system
3 virtual paths, a first active-system virtual path and a first standby-system

4 virtual path are reset to share a band assigned to said first active-system
5 transmission/reception section.

1 26 (Previously Presented). An apparatus according to claim 12, wherein
2 when a communication abnormality is detected in an active-system virtual
3 path, a band set for remaining normal active-system virtual paths is
4 limited, and a surplus band is used as a standby-system virtual path.

1 27 (Original). An apparatus according to claim 12, wherein a plurality of
2 active-system virtual paths and a plurality of standby-system virtual paths
3 are set, and said first control section controls said switch, in the event of
4 communication abnormalities in active-system virtual paths except for an
5 active-system virtual path assigned to a specific subscriber terminal for
6 which no protection is required, so as to switch the active-system virtual-
7 paths in which the communication abnormalities have occurred to standby-
8 system virtual paths except for a standby-system virtual path assigned to
9 said specific subscriber terminal.

1 28 (Previously Presented). An apparatus according to claim 12, wherein a
2 plurality of active-system virtual paths are set between said subscriber
3 terminals and a plurality of first transmission/reception means
4 corresponding to said active-system transmission/reception sections, a
5 standby-system virtual path forming a virtual path is set between said
6 subscriber terminal and second transmission/reception means
7 corresponding to said standby-system transmission/reception section, and
8 when an abnormality is detected in an active-system virtual path, the
9 active-system virtual path in which the abnormality has been detected is
10 switched to a standby-system virtual path by using a band held by said
11 second transmission/reception means.

1 29 (Previously Presented). A method according to claim 1, wherein said

2 step of transmitting transmits an ATM (Asynchronous Transmission
3 Mode) cell to one of a plurality of ports, to which said first active-system
4 transmission/reception section and said first standby-system
5 transmission/reception section are connected, in accordance with a header
6 added to the ATM cell.

1 30 (Currently Amended). A method according to claim 1, wherein said
2 step of transmitting transmits a data cell to one of a plurality of ports, ~~wo~~
3 which said first active-system transmission/reception section and said first
4 standby-system transmission/reception section are connected, in a
5 synchronous transfer mode in accordance with a time slot of a frame.